potent in securing the interest and attention of students, who instinctively recognize the difference between the teacher who merely transmits what others have said and done, and the one who as an active investigator has increased the store of knowledge.

Snyder's important researches on humus and the nitrogen of soils are well summarized and render this portion of the book especially valuable and complete, in showing quantitatively the increase and decrease of nitrogen under different methods of culture, largely on the basis of investigations made by the author himself. The entire subject of soil fertility and fertilization is so comprehensively yet briefly treated, that while nothing really essential is omitted, one is forcibly struck with the immensity of the field, and the total inadequacy of the time and preparation usually bestowed upon it even by those who are attempting to prepare themselves to be active workers in experiment stations. The one-sidedness and narrowness of the ordinary course of preparation for such activity is strongly emphasized by what, for brevity's sake, Snyder has to leave unsaid in this excellent book. But the practical applications of the facts and principles given are so well interwoven with the latter that "a peg is struck" in connection with each, in the mind of the reader or student, and will strike the practical farmer as well. To both classes of readers, and more especially to teachers of agriculture, this volume will be most welcome and useful.

Intended as the book is mostly for the temperate humid region, its omissions as concerns the arid region and the tropics are perhaps not a fair subject for criticism. The index is somewhat scantier than it should be for convenience of reference, when such subjects as alluvium, subsoil, leaching of soils, root penetration and others of similar importance, can not be conveniently located by its aid.

E. W. HILGARD

The New Physics and Its Evolution. By LUCIEN POINCARÉ. Authorized translation. Pp. 344. New York, D. Appleton & Co. 1908.

Professor Poincaré says in his preface:

> It has occurred to me that it might be useful to write a book which, while avoiding too great insistence on purely technical details, should try to make known the general results at which physicists have lately arrived, and to indicate the significance of the recent speculations on the constitution of matter and of the recent discussion of first principles.

One of the most interesting things to the physicist in this book is the author's insistence on the atomic theory as a fundamental principle which he would place on a par with the principle of the conservation of energy and the principle of Carnot and Clausius (the second law of thermodynamics). Indeed, it may be said, using the author's words, that the atomistic synthesis, but yesterday so decried, is to-day triumphant.

Professor Poincaré is one of the leading exponents of the view, which has always been held by the experimentalist, that the truth of a theory is solely its availability for use, and the value of Professor Poincaré's recent books lies to a great extent in the manner in which he sets this view before that great body of insistent and shameless theorists, the general public.

The scope of Professor Poincaré's book is sufficiently indicated by the above extract from his preface, and its quality is sufficiently indicated by the statement that it has an interest to the physicist and a value to the general reader. Let us, therefore, return to the paradoxical statement concerning the general public, our persistent and contented theorists, and let us illustrate by taking an example which every one should be able to appreciate. It is very well for a sailor, perceiving that the wind blows, to set his sails accordingly; and he usually knows well how to do it. But a sailor's grandson who sets himself to studying the wind, let him be careful how he uses the idea which pervades this simple perception.

> Even the apparently steady flow of a great river is an endlessly intricate combination of boiling and whirling motion; and the jet of spray from

a hydrant, or burst of steam from the safety valve of a locomotive, what is to be said of such things as these? Or let one consider the fitful motion of the wind as indicated by the swaying of trees or as actually visible in driven clouds of dust and smoke; or the sweep of the flames of a conflagration! Let one think of these things and consider whether it is not necessary to bring the mind to some narrow view before any clear line of argument can be pursued relative thereto.

Yes, it is necessary, and the simple idea of flowing, or, to put it in the usual way, the *idea of simple flow,* when properly and precisely defined[1] constitutes the basis of the science of hydraulics; but the general public is so content with ideas (theories) that they project them unreservedly into objectivity and that ends the matter in their minds. The wind blows and water flows, they say, and if one objects they claim that by blowing they mean *what the wind actually does,* although they admit they do not *know* it all. Maybe that is what they do mean, but such symbolism is worse than useless in science. A physical theory, or let us say rather, for the sake of intelligibility, a physical idea has in every case a *structural* content which represents more or less completely a condition or thing and you *do* know it all. A physical theory is, in fact, a working model in one's head such as the kinetic theory of gases, or the wave theory of light.

The general public indeed are not only content with simple practical ideas such as the idea that the wind blows, but they are theorists also in a weak and contemptible sense, so many of them learn elaborate theories which they never use—and think themselves fine. It is a good thing, this recent talk about truth's being availability for use, and many intelligent people would be surprised indeed if they could understand to what extent this axiom has been driven into scientific men.

But let us go back to the man who says that the wind blows and who thinks he has in mind what the wind actually does, and let us consider whether this man's interest is in the kinematics of the atmosphere or in the deeply laid plans of men which the wind *undoes* in havoc and disaster. Can there be any doubt as to what his interests really are, and as to what he really has in mind? It is little indeed that most men know of that remarkable quality of science, the quality of detachment. Science leaves human values mostly to art and to the arts, and the symbolism of the artist and of the business man is very different from the symbolism of science. It would seem, indeed, that art and business procedure can project themselves unreservedly into objectivity and stand unabashed; but with science it is not so. The ideas of flowing and blowing are true because the sailor and the lock-tender use them and they work; but the subtlety of nature is far beyond that of sense or of the understanding, and to project such simple ideas unreservedly into objectivity is to make an end to science.

There is at the present time a general awakening in philosophy and many scientific men seem to think that the world-wide talk on pragmatism is simply the first, long-delayed response of the great mass of men to the compelling philosophy of the experimental sciences, but it seems to the writer that this is by no means a complete diagnosis of the situation because some of the most striking features of the present philosophical movement are to be found in the transformation or reversion which the philosophy of the exact sciences is now undergoing. A period of remarkable activity in the physical sciences has been followed by a revolution in the conduct of business and industry, impressing the methods of the physical sciences upon great numbers of men, and the reciprocal effect is a growing domination of the exact sciences by a spirit of humanism, as pragmatism has been called in England. Indeed, the changes which human interests as a whole are creating in the philosophy of the exact sciences

[1] See pages 219–221 of Franklin and MacNutt's "Elements of Mechanics," The Macmillan Company, 1907. This book is unique as an attempt to supplement precision of ideas and definitions (with due deference to the reviewer in *Nature*, who says the book is very inaccurate and has no reason to be) with suggestive allusions to the subtleties of nature in order to fortify the student against the confusion of boundaries between our logical structures and the objective realms of reality, a confusion which, to use Münsterberg's phrase, is "the gravest danger of our time."

are no less profound and significant than the changes which the physical sciences have brought about in the conditions of human life.

The change which is taking place in the philosophy of the exact sciences is many sided, but a prominent feature of it is the passing away of an old point of view, namely, that nature is exact and unvarying, that the so-called laws of the physical sciences are ultimate realities, and that great simple facts of the physical universe are revealed in their perfection, one after another, to the divining spirit of mankind. It is not easy, however, to characterize the point of view which is now becoming dominant. In one way it may be described as a reenthronement of sense, and it may be exemplified by contrasting what is said above with the point of view of the author of one of our best modern engineering treatises on hydraulics as indicated by the following extract: "Galileo said in 1630 that the laws *controlling* the motion of the planets in their celestial orbits were better understood than those *governing* the motion of water on the surface of the earth. This is true to-day, for *the theory of the flow of water in pipes and channels has not yet been perfected.*" [Italics ours.] No! and it never will be Perfected! It would take too long to explain here just what is meant by this declaration, for, indeed, it has nothing to do with the fool idea, if, indeed, it can be called an idea, that "the finite can not comprehend the infinite" so that "we may not presume to point out all the ways in which a God of unbounded resources might govern the universe." From such inanity may the great God of little things deliver us!

Every student should realize two things in connection with his study of the physical sciences. The first is that the study of the physical sciences is exacting beyond all compromise, and the second is that the completest science stands abashed before the infinitely complicated array of phenomena of the material world except only in the assurance which its method gives.[2]

The new physics! Let no one imagine that what he calls results (which are in nearly every case, and especially in the popular mind, a more or less shameless projection of ideas into objectivity) constitute the new physics. The readiness with which the physicist can nowadays meet a new group of observable effects with adequate instrumental and theoretical tools is strikingly exemplified by the recent work in radioactivity. This facility of the modern scientific method in the realm of the physical sciences *is* the new physics, it is a realization of what Bacon long ago listed as one of the deficiencies of knowledge, namely, the Art of Inventing Arts, and the very essence of it is an increased realization of the fact that ideas are not things. Boundaries are no longer confused.

W. S. FRANKLIN

November 22, 1908

[2] Taken from a paper on "The Study of Science by Young People," *New York State Education Department Bulletin*, No. 431, pp. 65–94, September, 1908.

SCIENTIFIC JOURNALS AND ARTICLES

IN *The American Naturalist* for November Thos. H. Montgomery gives the results of "Further Studies on the Activities of Araneads," dealing with questions of the snares, senses of touch and sight, and the average duration of life. To some it will seem a pity that the term Araneids was not used, since this termination has been much used by zoologists. Floyd E. Chidester has "Notes on the Daily Life and Food of *Cambarus bartonius bartoni*," and Austin H. Clark describes "Some Points in the Ecology of Recent Crinoids," noting some of the factors that influence their size and distribution. Shorter articles are "Evolution Without Isolation" and "A Note on the [Spawning] of the Silverside." The book reviews are unusually full and important, especially those on "The Origin of a Land Flora" and "The Animal Mind."

The American Museum Journal for December contains an illustrated article on the "Exhibit Illustrating the Evolution of the Horse" in which it is noted that the American Museum collections of fossil horses are larger than those of all other museums put together. The "Department of Mineralogy" records the reception of what is probably the largest mass of polybasite ever taken from a mine. It is announced that the "Tuberculosis Exhibit" installed in the new wing on Columbus Avenue, will remain open for several weeks.